

Software Testing and Validation – 2017/18
Instituto Superior Técnico

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Vos
Project Report

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1 Method-Scope Tests

1.1 assignPhoneNumber

Assigns a free phone number to a client of *Vos* if all conditions are met. If at least one does not hold, then this method does not change anything, throwing an `InvalidOperationException`.

1.1.1 Test Pattern – Category-Partition Test

1.1.2 Functions

- Primary function
 - Assign free phone number to a client without a number
- Secondary functions
 - Throw `InvalidOperationException` if conditions aren't met
 - * Invalid nif ($\text{nif} \notin [10^8, 10^9[$)
 - * A *Vos* client with the given nif doesn't exist
 - * Invalid phone number ($\text{number} \notin [10^8, 10^9[$)
 - * It isn't a *Vos* number
 - * Phone number already assigned
 - * Client can't be assigned any more numbers

1.1.3 Input/Output Parameters

- Input
 - `clientNif` – The nif of the client to assign a number to
 - `phoneNumber` – The phone number to be assigned
 - `clients` – The set of *Vos* clients managed by `ClientManager`
- Output
 - `client` – The updated client, if a number was assigned successfully

1.1.4 Categories & Choices

Parameter	Category	Choices
<code>clientNif</code>	<i>Vos</i> client (w/ $\#numbers$ phone numbers)	$\#numbers \in [1, 5[$ $\#numbers = 5$ (MAX)
	Not a <i>Vos</i> client	<code>clientNif</code> $\in [10^8, 10^9[$
	Invalid nif	<code>clientNif</code> $\notin [10^8, 10^9[$
<code>phoneNumber</code>	<i>Vos</i> phone number	Free (Unassigned) Not free (Assigned)
	Not a <i>Vos</i> number	<code>phoneNumber</code> $\in [10^8, 10^9[$
	Invalid number	<code>phoneNumber</code> $\notin [10^8, 10^9[$
<code>clients</code>	n -elements	$n = 0$ (Empty)
		$n \in [1, \text{MAX}]$ (Not empty)

Table 1: Set of `assignPhoneNumber`'s input parameters broken into categories, accompanied by test case choices

1.1.5 Constraints

- Empty **clients** list precludes the assignment of a **phoneNumber** to a client (which, since the list is empty, mustn't exist)
- Assigning an invalid **phoneNumber**, one that doesn't belong to *Vos* or one that is already assigned is the same for any kind of client

1.1.6 Test Cases

TC	Choices			Expected Result	
	clientNif	phoneNumber	clients	Exception	client
1	$\#numbers \in [1, 5[$	Free	$n \in [1, MAX]$	NO	$\#numbers \in]1, 5]$
2	$\#numbers \in [1, 5[$	Not free	$n \in [1, MAX]$	YES	—
3	$\#numbers \in [1, 5[$	$\in [10^8, 10^9[$	$n \in [1, MAX]$	YES	—
4	$\#numbers \in [1, 5[$	$\notin [10^8, 10^9[$	$n \in [1, MAX]$	YES	—
5	$\#numbers = 5$	Free	$n \in [1, MAX]$	YES	—
6	$\in [10^8, 10^9[$	Free	$n \in [1, MAX]$	YES	—
7	$\notin [10^8, 10^9[$	Free	$n \in [1, MAX]$	YES	—

Table 2: Set of reduced test cases for the **assignPhoneNumber** method after constraints are applied

1.2 computeBill method

The responsibility of `computeBill` method is to determine the value to pay for a client taking into account all communications made by the client through all of his registered mobile phones

1.2.1 Test Pattern – Combinational Function Test

1.2.2 Decision Tree

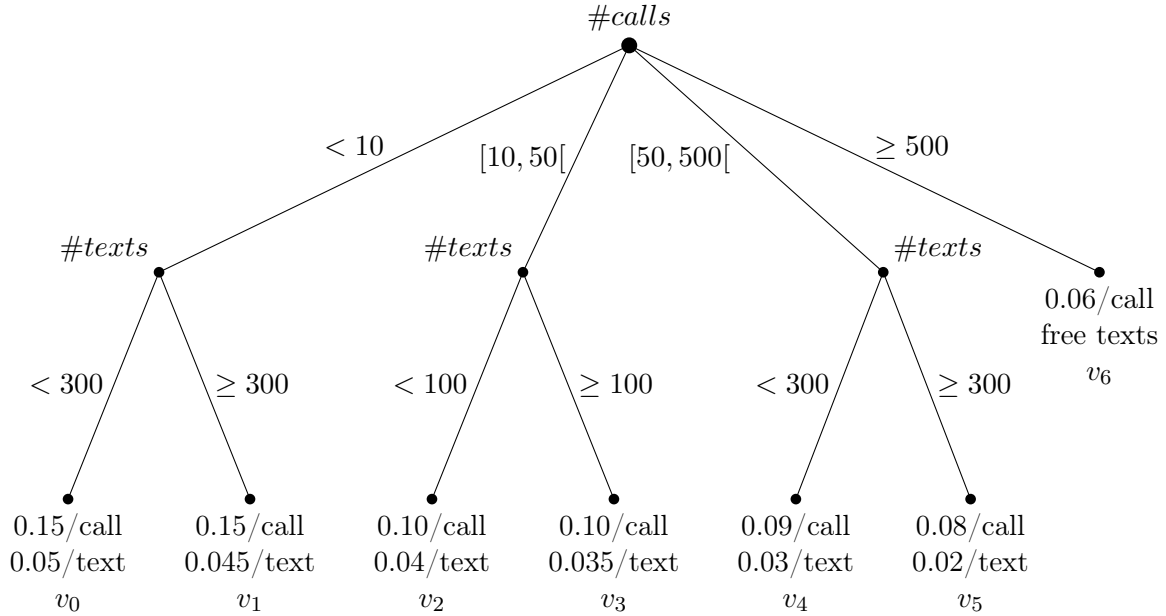


Figure 1: Decision tree describing the output given by `computeBill` based on the number of texts sent and calls made by the client

1.2.3 Domain Matrices

v_0			Test Cases			
Variable	Condition	Type	—	1	—	2
#calls	< 10	ON	10			
		OFF		9		
	Typical	IN			8	7
#texts	< 300	ON			300	
		OFF				299
	Typical	IN	147	204		
Expected Result			v_3	11.55	v_1	16.00

Table 3: v_0 domain matrix

v_1			Test Cases			
Variable	Condition	Type	—	3	4	—
#calls	< 10	ON	10			
		OFF		9		
	Typical	IN			6	5
#texts	≥ 300	ON			300	
		OFF				299
	Typical	IN	320	400		
Expected Result			v_3	19.35	14.40	v_0

Table 4: v_1 domain matrix

v_2			Test Cases					
Variable	Condition	Type	5	—	—	6	—	7
#calls	≥ 10	ON	10					
		OFF		9				
	< 50	ON			50			
		OFF				49		
	Typical	IN					22	35
#texts	< 100	ON					100	
		OFF						99
	Typical	IN	48	20	33	15		
Expected Result			2.92	v_0	v_4	5.50	v_3	7.46

Table 5: v_2 domain matrix

v_3			Test Cases					
Variable	Condition	Type	8	—	—	9	10	—
#calls	≥ 10	ON	10					
		OFF		9				
	< 50	ON			50			
		OFF				49		
	Typical	IN					12	44
#texts	≥ 100	ON					100	
		OFF						99
	Typical	IN	148	220	333	414		
Expected Result			6.18	v_0	v_5	15.49	4.70	v_2

Table 6: v_3 domain matrix

v_4			Test Cases					
Variable	Condition	Type	11	—	—	12	—	13
#calls	≥ 50	ON	50					
		OFF		49				
	< 500	ON			500			
		OFF				499		
	Typical	IN					142	51
#texts	< 300	ON					300	
		OFF						299
	Typical	IN	240	189	98	10		
Expected Result			11.70	v_3	v_6	45.21	v_5	13.56

Table 7: v_4 domain matrix

v_5			Test Cases					
Variable	Condition	Type	14	—	—	15	16	—
#calls	≥ 50	ON	50					
		OFF		49				
	< 500	ON			500			
		OFF				499		
	Typical	IN					200	60
#texts	≥ 300	ON					300	
		OFF						299
	Typical	IN	314	500	616	404		
Expected Result			10.28	v_3	v_6	48.00	22.00	v_4

Table 8: v_5 domain matrix

v_6			Test Cases	
Variable	Condition	Type	17	—
$\#calls$	≥ 500	ON	500	
		OFF		499
Expected Result			30.00	v_4/v_5

Table 9: v_6 domain matrix

2 Class-Scope Tests

2.1 Client class

Each client of *Vos* has a name (with a minimal length of 5) and by its social security number (designated as *nif*). This number is a unique identifier in *Vos*. A client can have several phone numbers managed by *Vos* (between 1 and 5). Each client can associate a mobile phone to each of his assigned phone numbers.

Each client can register in the system a given amount of phone number of *friends*. The maximum number of phone number a client can register is equal to three times the number of phone numbers plus five.

2.1.1 Test Pattern – Non-Modal Class Test

2.1.2 Class Invariant

Domain restrictions

Client variables	
Variable	Type
<code>name</code>	<code>String</code>
<code>nif</code>	<code>int</code>
<code>numbers</code>	<code>List<Integer></code>
<code>friends</code>	<code>List<Integer></code>

- `name.length() ≥ 5`
- `nif ∈ [108, 109[`
- `numbers.size() ∈ [1, 5]`
- `friends.size() ≤ 3 × numbers.size() + 5`

Table 10: **Client** class' variables and their respective types

The logical conjunction of all of these restrictions makes up the Class Invariant

2.1.3 On and Off points

Boundary	ON	OFF
<code>name.length() ≥ 5</code>	5	4
<code>nif ≥ 10⁸</code>	10 ⁸	10 ⁸ – 1
<code>nif < 10⁹</code>	10 ⁹	10 ⁹ – 1
<code>numbers.size() ≥ 1</code>	1	0
<code>numbers.size() < 5</code>	5	4
<code>friends.size() ≤ 3n¹ + 5</code>	3n + 5	3n + 6

Table 11: On and Off points for the **Client** class' invariant boundaries

¹`numbers.size()`

2.1.4 Domain Matrix

Boundary			Test Cases											
Variable	Condition	Type	1	2	3	4	5	6	7	8	9	10	11	12
name.length()	≥ 5	ON	5											
		OFF		4										
nif	Typical	IN			6	7	8	9	10	11	12	13	14	15
	≥ 10 ⁸	ON			10 ⁸									
		OFF				10 ⁸ − 1								
	< 10 ⁹	ON					10 ⁹							
		OFF						10 ⁹ − 1						
	Typical	IN	10 ⁸ + 1	10 ⁸ + 2				10 ⁹ − 1	10 ⁸ + 3	10 ⁸ + 4	10 ⁸ + 5	10 ⁸ + 6	10 ⁸ + 7	10 ⁸ + 8
numbers.size()	≥ 1	ON							1					
		OFF								0				
	< 5	ON									5			
		OFF										4		
	Typical	IN	2	3	4	3	2	3					4	3
friends.size()	≤ 3n + 5	ON											17	
		OFF												15
	Typical	IN	0	1	2	3	4	5	6	7	8	9	Y	N
Expected Result			Y	N	Y	N	N	Y	Y	N	N	Y	Y	N

Table 12: Client class test cases

2.2 Mobile class

A mobile phone can make and receive calls and send and receive texts. A mobile phone can be turned on or off (and in this case it cannot make calls, send texts and receive calls nor texts). It has two modes (*friend* and *silent*) that can be enabled or disabled.

2.2.1 Test Pattern – Modal Class Test

2.2.2 Finite State Machine

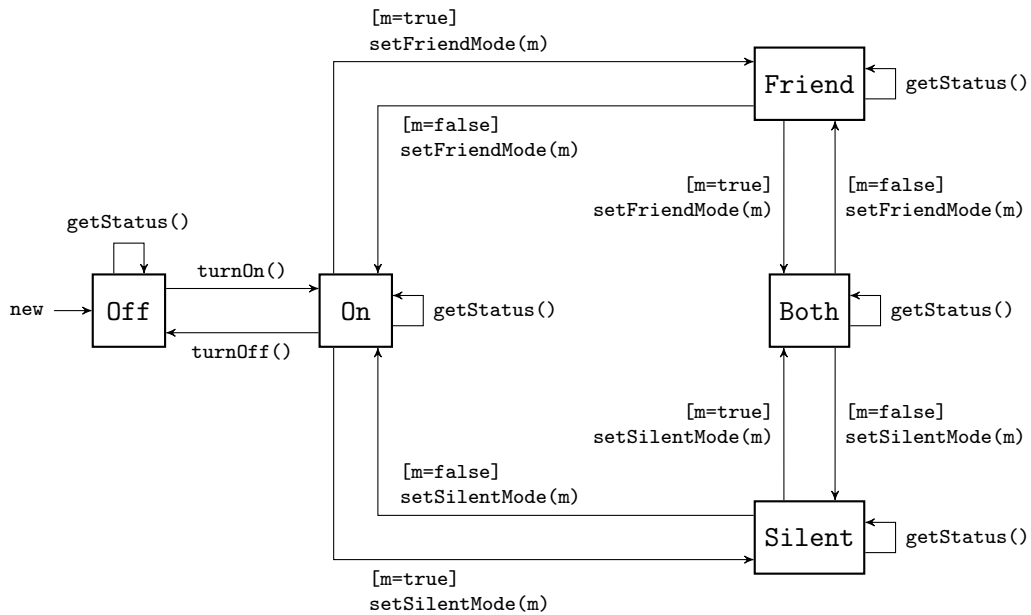


Figure 2: Mobile class state machine, representing the class' states and transitions between them

2.2.3 Transition Tree

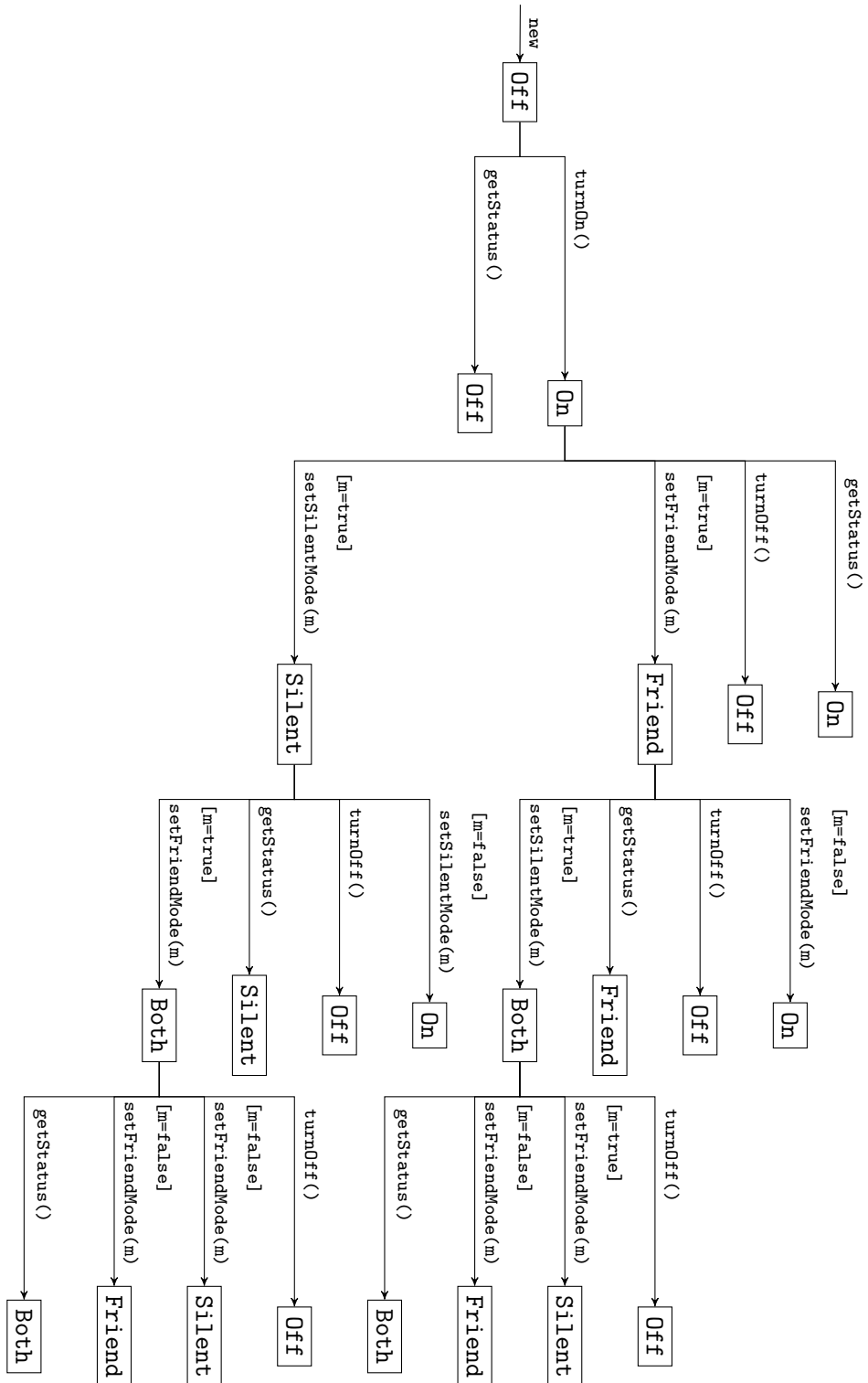


Figure 3: Mobile class transition tree